

**WHAT IS CLAIMED IS:**

1. A method of performing downstream adaptive modulation in an MMDS, broadband, fixed wireless communication system having a base station with a transmitter-receiver and one or more CPE devices each having a transmitter-receiver, the system  
5 utilizing a DOCSIS MAC pursuant to which the DPU is a variable length, Ethernet-type data packet, which comprises:

operating the base station to transmit data downstream to the CPE devices in a plurality of data modulation modes;

assigning one of the modulation modes to each respective CPE device;

10 monitoring the quality of downstream data transmission to, and reception by, each CPE device; and

15 if the quality of downstream data transmission to and reception by any CPE device receiving data in its assigned modulation mode lies outside a predetermined quality range, assigning a different modulating mode to such CPE device, the different mode rendering the data transmission quality within the predetermined quality range.

2. The method of Claim 1, wherein:

the monitoring step is effected by monitoring and analyzing upstream messages from the CPE devices.

3. The method of Claim 2, wherein:

the quality range is zero and is effectively a break point between acceptable and unacceptable quality, the predetermined quality range representing acceptable quality and, if the quality of downstream data transmission to and reception by any CPE device receiving data in its assigned modulation mode is acceptable, no different modulation mode is assigned by the base station.

4. The method of Claim 2, wherein:

the quality range is non-zero and represents acceptable quality, quality higher than the range being superior and quality below the range being unacceptable, and assigning a higher quality modulation mode to the affected CPE device if its reception quality is unacceptable or assigning a lower quality modulation range to the affected CPE device if its reception quality is superior, and permitting the modulation mode of the CPE device to remain unchanged if its reception quality is acceptable.

5. The method of Claim 1, wherein:

each data modulation mode is a QAM mode that includes a group of tones and has a selected transmission time.

6. The method of Claim 5, wherein the data modulation modes are  $N^A$  QAM tones,  $N^B$  QAM tones,  $N^C$  QAM tones... $N^Z$  QAM tones, where  $A < B < C < \dots < Z$ .

7. The method of Claim 6, wherein  $N=4$ ,  $A=0$ ,  $B=A+1$ ,  $C=B+1 \dots Z=Y+1$ .

8. The method of Claim 5, wherein:

each tone group comprises a selected constellation density.

9. The method of Claim 8, wherein:

each tone group has a constant bit rate.

5 10. The method of Claim 1, wherein:

the assigning steps are effected by the base station transmitting downstream  
messages to the CPE devices.

11. The method of Claim 1, wherein:

the monitoring step is effected by the base station receiving and analyzing upstream  
10 ARQ messages transmitted by the CPE devices.

12. The method of Claim 1, wherein:

at any given time the base station transmits data simultaneously on all of the  
modulation modes, but each CPE device receives data only on the modulation mode then  
assigned thereto.

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13. A method of performing downstream adaptive modulation in an MMDS, broadband, fixed wireless communication system having a base station with a first transmitter-receiver and one or more CPE devices each having a second transmitter-receiver, the system utilizing a DOCSIS MAC pursuant to which the DPU is a variable length,  
5 Ethernet-type data packet, which comprises:

operating the base station to transmit data downstream to the CPE devices in a plurality of QAM modes each of which includes a group of tones, a predetermined transmission time, a predetermined constellation density and a constant bit rate;

operating the base station to transmit training messages to the CPE devices to  
10 assign to each CPE device a selected one of the QAM modes;

operating each CPE device to transmit ARQ messages to the base station  
when data is improperly received by such CPE device;

operating the base station to monitor the quality of downstream data  
transmission to and reception by each CPE device by receiving and analyzing ARQ  
15 messages, a predetermined number of ARQ messages from a given CPE device indicating  
that the quality of data transmission to such CPE device is acceptable, a number of ARQ  
messages greater than the predetermined number indicating unacceptable quality; and

assigning a higher quality QAM mode to any CPE device that transmits a  
number of ARQ messages greater than the predetermined number and assigning a lower  
20 quality QAM mode to any CPE device that transmits a number of ARQ messages less than  
the predetermined number.

14. The method of Claim 13, wherein the QAM mode of any CPE device  
transmitting ARQ messages equal to the predetermined number remains unchanged.

15. Apparatus for performing downstream adaptive modulation in an MMDS, broadband, fixed wireless communication system having a base station with a transmitter-receiver and one or more CPE devices each having a transmitter-receiver, the system utilizing a DOCSIS MAC pursuant to which the DPU is a variable length, Ethernet-type data packet, which comprises:

first facilities in the base station for transmitting data downstream to the CPE devices in a plurality of data modulation modes;

second facilities in the base station for assigning a respective modulation mode to each respective CPE device;

third facilities in the base station for monitoring the quality of downstream data transmission to and reception by each CPE device; and

fourth facilities in the base station for determining if downstream data transmission quality to and reception by any CPE device receiving data in its assigned modulation mode lies outside a predetermined quality range for assigning a different modulating mode to such CPE device which different mode adjusts the data transmission quality to be within the predetermined quality range.

16. The apparatus of Claim 15, wherein the third facilities effect the monitoring step by monitoring and analyzing upstream messages from the CPE devices.

17. The apparatus of Claim 16, wherein the quality range is zero and is effectively a break point between acceptable and unacceptable quality with the predetermined quality range representing acceptable quality, and if the quality of downstream data transmission to

and reception by any CPE device receiving data in its assigned modulation mode is acceptable, the fourth facilities assign no different modulation mode.

18. The apparatus of Claim 16, wherein the quality range representing acceptable quality is non-zero, quality higher than the range is superior and quality below the range is unacceptable; and wherein the fourth facility: (i) assigns a higher quality modulation mode to the affected CPE device if its reception quality is unacceptable, (ii) assigns a lower quality modulation range to the affected CPE device if its reception quality is superior, and (iii) permits the modulation mode of the affected CPE device to remain unchanged if its reception quality is acceptable.

19. The apparatus of Claim 15, wherein each data modulation mode is a QAM mode that includes a group of tones and has a selected transmission time.

20. The apparatus of Claim 19, wherein the data modulation modes are  $N^A$  QAM tones,  $N^B$  QAM tones,  $N^C$  QAM tones... $N^Z$  QAM tones, where  $A < B < C < \dots < Z$ .

21. The apparatus of Claim 20, wherein  $N=4$ ,  $A=0$ ,  $B=A+1$ ,  $C=B+1 \dots Z=Y+1$ .

22. The apparatus of Claim 19, wherein each tone group comprises a selected constellation density.

23. The apparatus of Claim 19, wherein each tone group has a constant bit rate.

24. The apparatus of Claim 18, wherein the second facilities transmit training messages to the CPE devices in order to effect the assigning function.

25. The apparatus of Claim 18, wherein the third facilities receive and analyze the upstream ARQ messages transmitted by the CPE devices.

26. The apparatus of Claim 18, wherein at any given time the first facilities transmit data simultaneously on all of the modulation modes, but each CPE device receives  
5 data only on the modulation mode then assigned thereto.

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27. An apparatus for performing downstream adaptive modulation in an MMDS, broadband, fixed wireless communication system having a base station with a first transmitter-receiver and one or more CPE devices each having a second transmitter-receiver, the system utilizing a DOCSIS MAC pursuant to which the DPU is a variable length,  
5 Ethernet-type data packet, which comprises:

first means in the base station for transmitting data downstream to the CPE devices in a plurality of QAM modes each of which includes a group of tones, a predetermined transmission time, a predetermined constellation density and a constant bit rate;

10 second means in the base station for transmitting training messages to the CPE devices to assign to each CPE device only a selected one of the QAM modes;

facilities in each CPE device for transmitting ARQ messages to the base station when data is improperly received by such CPE device;

15 third means in the base station for monitoring the quality of downstream data transmission to and reception by each CPE device by receiving and analyzing ARQ messages, a predetermined number of ARQ messages from a given CPE device indicating that the quality of data transmission to such CPE device is acceptable, a number of ARQ messages greater than the predetermined number indicating unacceptable quality; and

20 fourth means in the base station operating in conjunction with the second means for assigning a higher quality QAM mode to any CPE device that transmits a number of ARQ messages greater than the predetermined number and assigning a lower quality QAM mode to any CPE device that transmits a number of ARQ messages less than the predetermined number.



28. The apparatus of Claim 27, wherein the QAM mode of any CPE device transmitting ARQ messages equal to the predetermined number remains unchanged.

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